Pigment Formation in the Eye of *Ephestia* and Its Genic Determination.

ERNST CASPARI.

Wesleyan University, Middletown, Conn.

In the study of the eye pigments of the meal moth *Ephestia*, the integration of embryological, biochemical and genetic analysis has proceeded so far as to give a consistent picture of the interaction of these factors. Pigments occur in three types of cells, primary pigment cells, accessory pigment cells, and retinula cells. The pigment in the latter two types of cells is deposited in small brown granules insoluble in water, while a yellow, water-soluble pigment is found in the primary pigment cells.

The chemical behavior of these pigments is known from the investigations of Becker (1942). The brown pigment is a substance with well-defined chemical characteristics different from melanin, which has been given the name "skotommin." Skotommin is derived from tryptophane according to the scheme: Tryptophane → kynurenin → oxykynurenin → pigment.

Developmentally, pigment appears first in the retinula cells. Pigment formation starts in these cells in the prepupa, and spreads gradually over the eye in the first 9 days of pupal life. Pigment appears in the accessory pigment cells about 10 days after pupation, in the primary pigment cells a few days later. Pigment formation in the accessory pigment cells has been more thoroughly described by Hanser (1948). The first thing to appear are very small precursor granules which enlarge under deposition of pigment on their surface. These precursor granules persist as the core of the final pigment granule. By enzymatic digestion experiments it could be demonstrated that the precursor granules contain ribonucleoproteins (Caspari and Richards, 1948).

Two genes affecting the pigmentation of the eye have been studied, *a* and *wa*. *a* interferes with the transformation of tryptophane to kynurenin, and in this way reduces the amount of skotommin pigment by 80-90%. The size of pigment granules is decreased. *wa* inhibits the formation of pigment completely, but does not interfere with the production of kynurenin. Hanser found that in *wa wa* animals the precursor granules are not formed.

aa animals can form large amounts of skotommin if supplied with kynurenin either by transplantation of wild type organs (Caspari, 1933) or by injection. In this way it can be shown that the different types of cells of the eye have different "sensitive periods" in which they are competent to react on supply of kynurenin with pigment formation (Hanser, 1948). These sensitive periods start somewhat earlier than the periods in which pigment formation can be observed, and continue through the time of visible pigment formation. In accessory pigment cells, the sensitive period seems to start at about the time when the precursor granules become visible.

From these experiments the following picture of pigment formation arises. For the formation of pigment granules, at least two conditions are necessary: the presence of kynurenin, the chemical precursor of the pigment, and the ribonucleoprotein containing granules. While the latter are not necessary for the formation of kynurenin, they probably have some function in transforming it into the pigment. Kynurenin is formed throughout the larval and pupal stages in all organs investigated (Caspari, 1949). Different cells acquire at different stages of their development the ability to react on kynurenin supply with formation of pigment. This stage of competence seems to be correlated with the appearance of the precursor granules, and forms the developmental basis of the sensitive period. Genes may interact with pigment formation by affecting either kynurenin formation (*a*) or the formation of precursor granules (*wa*).

BIBLIOGRAPHY.

BECKER, E. Uber Eigenschaften, Verbreitung und die genetisch-entwicklungsphysiologische Bedeutung der Pigmente der Ommatin-und Ommingruppe (Ommochrome) bei den Arthropoden. *Z. ind. Abst.-Vererb.*, 80:157-204, 1942.

CASPARI, E. Uber die Wirkung eines pleiotropen Gens bei der Mehlmotte *Ephestia kühniella* Z. *Arch. Entwmech. Org.*, 130:253-281, 1933.

———— Physiological action of eye color mutants in the moths *Ephestia kühniella* and *Ptychopoda seriata*. *Quart. Rev. Biol.*, 24:185-199, 1949.

———— and J. RICHARDS. Genic action. Yb. Carnegie Inst. Wash., 47:183-189, 1948.

HANSER, G. Uber die Histogenese der Augenpigmentgranula bei verschiedenen Rassen von *Ephestia kühniella* Z. und *Ptychopoda seriata* Schrk. *Z. ind. Abst.-Vererb.*, 82:74-97, 1948.

Problems of Origin and Migration of Pigment Cells in Fish.

H. B. GOODRICH.

Wesleyan University, Middletown, Conn.

In two papers published in 1915 Charles Stockard observed the origin of yolk sac chromatophores in *Fundulus* from chromatoblasts which migrated from the region of the closure of the blastopore and from the